

TENNESSEE VALLEY AUTHORITY

**River Basin Operations
Water Resources**

**RESULTS OF FISH TISSUE SCREENING STUDIES
FROM SITES IN THE TENNESSEE
AND CUMBERLAND RIVERS
IN 1988**

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Chattanooga, Tennessee

July 1990

TVA, 1990

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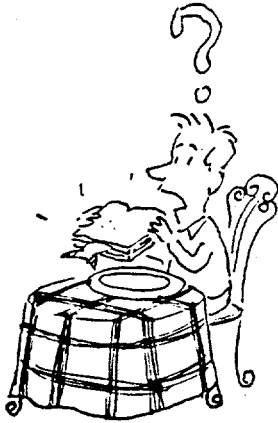
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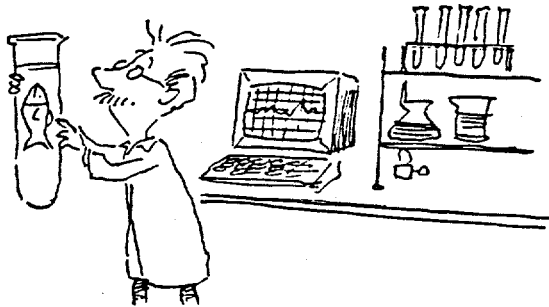
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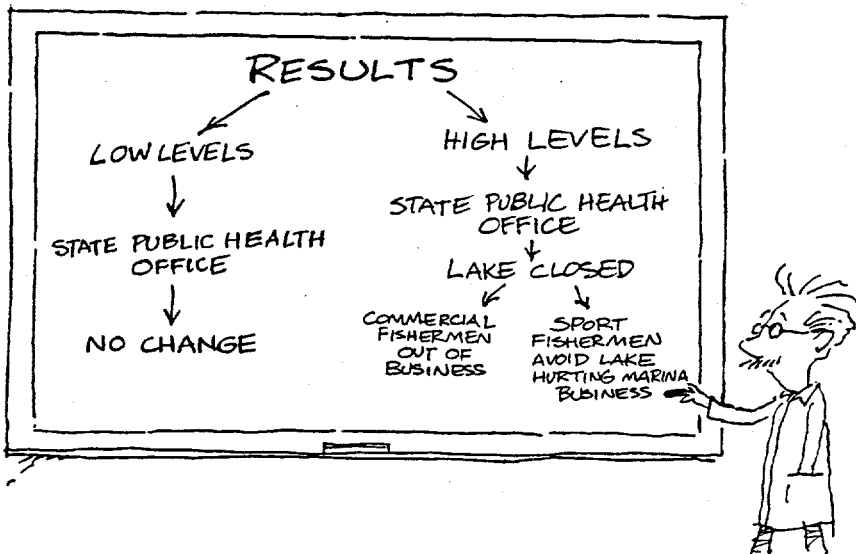
VALLEY-WIDE FISH TISSUE STUDY



You can't tell a fish
by it's cover--is it
safe to eat?



Routine, cooperative
monitoring by State,
Federal, and other
interested agencies is
necessary to ensure
protection of public
health.



Results are provided to
all involved parties
and are used by State
officials to advise the
public appropriately.

(coordinated by Tennessee Valley Authority)

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EXECUTIVE SUMMARY

This report provides results from a cooperative effort between TVA and other federal and state agencies in the Tennessee Valley. The primary use of these screening results is to direct future efforts. If tissue levels are high compared to preselected concentrations, then an intensive investigation for that reservoir is undertaken in cooperation with appropriate state agencies. If concentrations are low, then that reservoir will be revisited in three years at the screening level. The 1988 results did not indicate need for intensive investigation at any reservoirs in addition to those already planned for Autumn 1989 on Fort Loudoun, Tellico, Watts Bar, Nickajack, and Wilson Reservoirs. The 1988 results agreed with previous results that, although no single factor appeared problematic, presence of several toxicants coupled with poor condition of fish examined indicated a stressed aquatic environment in Parksville Reservoir and in John Sevier Detention Pool.

RESULTS OF FISH TISSUE SCREENING STUDIES FROM SITES
IN THE TENNESSEE AND CUMBERLAND RIVERS
IN 1988

INTRODUCTION

TVA analyzes tissues of Tennessee Valley area fish as part of intensive evaluations and as part of screening level evaluations. Intensive studies are conducted in reservoirs where contamination problems are known or suspected and include analysis of individual fillets from important fish species from several areas in the reservoir. This information is used by State public health officials to determine whether fish consumption advisories are necessary to protect human health. Screening studies are based on analysis of composite rather than individual samples and are intended to provide trend information and to identify areas where problems may exist indicating need for an intensive evaluation. All studies are coordinated with State agencies because they ultimately must make management decisions regarding public health.

TVA has two fish tissue screening programs. One examines fish on an annual basis at inflow points from eight of the major tributaries into the Tennessee River reservoir system. The other examines fish from within the reservoirs on a rotating basis with the goal of sampling each reservoir at least once every three years. To differentiate between the studies, areas sampled as part the annual effort at inflow points are called Fish Tissue-Inflow (FT-I) sites and areas included in the reservoir efforts are called Fish Tissue-Reservoirs (FT-R) sites.

This differentiation is necessary for the two studies because they have different objectives and slightly different protocols. FT-I is intended to identify year-to-year trends of contaminants (toxics) entering the reservoir system from major watersheds using tissue from catfish, rough fish, and game fish as the indicator tool. This program started in 1986.

FT-R is intended to screen toxics levels in fish from throughout the Tennessee Valley in coordination with other organizations involved in such studies. Communication with State, Federal, and industry-based biologists avoids duplication of effort. The FT-R study depends on these biologists to supply some of the fish for analysis. TVA collects fish from the remaining sites, analyzes all fish, and provides results to the cooperating groups.

Results from FT-R are intended to lead to one of three alternatives. If all values for toxics in fish flesh from a reservoir are low (termed Tier 1), that reservoir will be resampled in about three years. If high (termed Tier 3), it will be recommended for intensive study with details and funding sources developed by all involved organizations. If levels of toxics are between these extremes (termed Tier 2), that reservoir will be sampled again the next year at the screening level to better determine whether a problem exists. Values termed low and high were selected a priori from a combination of sources including Food and Drug Administration (FDA) tolerances and action levels (FDA, 1987), Preliminary Guidance Values (Travis et al., 1986), and subjective evaluation based on experience with such studies in the Tennessee Valley. Specific tier levels for each contaminant included in this study are provided in table 1.

This report presents the 1988 results from these two screening studies. There are two reports which provide results of these screening studies from previous years. TVA (1988) provides results from the initial year (1986) of the FT-I study, and TVA (1989b) provides results from fish collected in 1987, which was the first year of the FT-R study and second year of the FT-I study.

Results of intensive fish tissue studies conducted in 1988 are reported separately. These include Nickajack Reservoir (in preparation); Chickamauga Reservoir (TVA, 1990); and Fort Loudoun, Tellico, and Watts Bar Reservoirs (in preparation).

MATERIALS AND METHODS

Collection Sites

Figure 1 highlights the eight FT-I sites sampled annually and the FT-R sites sampled in 1988. Appendix A identifies river mile locations for each collection site and shows availability of historic information for each site. Appendix A also identifies sites sampled in 1988 as part of other studies.

Study Species

Fish collected for analysis for FT-I include game fish, catfish, and rough fish. Species are listed below in order of preference within each category. If five individuals of the most preferred species within a category could not be collected, individuals from the next preferred species were substituted to achieve the full complement of five.

<u>Game</u>	<u>Catfish</u>	<u>Rough</u>
Largemouth bass	Channel	Carp
Crappies	Blue	Freshwater drum
Spotted bass	Flathead	Buffalos
Smallmouth bass	Bullhead	Redhorses
Bluegill		
Other sunfishes		

Because FT-R is a broad screening effort, a single indicator species, channel catfish, is used to allow greatest coverage of the Valley at the lowest possible cost. Channel catfish was selected because it is highly sought by commercial and sport fisherman and because catfish typically have high levels of most toxics compared to other species. Five channel catfish (supplemented by blue catfish only as a last resort) is the desired number for collection at each site.

Sample Processing

Following collection, all fish are immediately placed on ice until processing. Prior to processing, each fish is measured, weighed, and external condition noted. All fish are filleted with care taken to include all flesh. Ribs and belly flap are left on the fillet. Fish sex and condition of internal organs are noted prior to filleting. Skin is left on game and rough fish (scales removed), but skin is removed from catfish. Fillets are rinsed in cold water, weighed, individually wrapped in aluminum foil, and placed in separate, labeled, plastic bags. Samples are frozen immediately following processing, and stored frozen until laboratory analysis.

Laboratory Analyses

Laboratory analyses for both FT-R and FT-I studies are performed on composited fillets (five fish per composite) where each fillet is individually homogenized and an equal aliquot withdrawn from each fillet to prevent size bias. For the FT-R study, livers are also retained for analysis to serve as environmental indicators. Analyses on composited fillets include lipid content and priority pollutant metals, pesticides, and PCBs (table 1 and appendix B, table B1). For those organics where the Environmental Protection Agency (EPA) priority pollutant list includes more than one isomer or metabolite (e.g., alpha, beta, and gamma BHC or endrin and endrin aldehyde), these are analyzed separately in the laboratory but reported here as a total value. Livers are analyzed only for metals. All data are stored on EPA's STORET system.

RESULTS AND DISCUSSION

Specific data (collection date, species, sex, lab identification number, length, and weight) for each of the 238 fish in the 1988 collections is provided in table 2. The lab identification number (LABID) relates the physical information in table 2 to information on tissue levels of metals and organics provided in tables 3 and 4, respectively. Fish with the same LABID number in table 2 were composited for laboratory analysis.

During the initial year of the FT-R study (1987), failure to collect fish from eight of the planned sites showed a need for better coordination among agencies. The primary cause for this was that TVA

requested assistance from participating State agencies too late in the year for them to accommodate the request. Two steps were taken in 1988 to alleviate this problem--first, TVA made requests to States earlier in the year; and second, where State agencies did not commit to collect fish, TVA biologists made collections (to the extent possible). This resulted in collections being missed at only the following four FT-R sites in 1988: one site on Kentucky Reservoir at Tennessee River mile (TRM) 135; one site on Wheeler Reservoir at TRM 275; and two sites on Tims Ford Reservoir at Elk River miles 135 and 150.

Fish were collected and analyzed from two FT-R sites in 1988 that were not included in initial plans. For Nottely Reservoir, although fish had been collected there in 1987, collections were repeated in 1988 to complement results from the other four major reservoirs on the Hiwassee River that were sampled in 1988. For Cherokee Reservoir (Holston River mile 53), flathead catfish were analyzed at the request of the Tennessee Wildlife Resources Agency.

Fish were collected from only six of the eight FT-I sites in 1988. Missed collections at Duck River mile 18 and Elk River mile 31 were due to oversight by TVA biologists.

Physical Condition of Fish

External examinations indicated most fish collected in this study were healthy and had no noteworthy anomalies. Of a total of 238 fish, three were in poor condition, two had exophthalmic eyes (pop-eye), two had fin rot, and two had skin lesions. The low occurrence of these observations indicates fairly healthy populations. However, four of

these anomalies were noted at the FT-I site on the Holston River (mile 110)--one largemouth bass and one carp had skin lesions and two carp had fin rot. These observations tend to indicate stressed conditions at that site.

Observations on internal organs also indicated most fish were healthy. The only noteworthy observations were that eight fish had parasites (primarily on the liver) and four had discolored livers. All of these fish were otherwise healthy. Interestingly, the high occurrence of parasites in catfish from the Cumberland River sites in 1987 collections was not apparent in catfish collected in 1988. Ten of twelve catfish from mid and upper Barkley Reservoir had parasites in 1987, but none of the 20 from the Cumberland River reservoirs (five specifically from Barkley) sampled in 1988 were noted to have parasites.

Metals

Table 3 provides results of laboratory analyses for metals on the 48 composited fillet samples. Antimony, copper, and silver were not detected in any samples. The apparent absence of copper was actually due to using a relatively high detection limit (2.0 µg/g) on these fish. There is no doubt that copper was present in these fish because it is an essential element for life. The higher detection limit reported was necessary because copper was present in laboratory blanks analyzed in conjunction with these samples. Samples were not reanalyzed because copper concentrations would have had to be substantially above 2.0 µg/g to be considered a problem. Three other metals (beryllium, nickel, and thallium) which were not detected in 1987 samples, were detected in a few samples from the 1988 collections at concentrations slightly above

detection limits. Beryllium was found in one sample at a concentration of 0.04 $\mu\text{g/g}$ (detection limit of 0.02 $\mu\text{g/g}$). Nickel and thallium, typically not documented in fish tissue samples from the Tennessee Valley, were found at concentrations slightly above the detection limit of 1.0 $\mu\text{g/g}$.

Lead, selenium, and zinc were found in all fillet composites. Selenium and zinc are essential elements for life and are usually found in fish tissue samples. Lead is a common environmental pollutant due to its many industrial uses. Zinc is seldom a problem, although both lead and selenium can be problematic in sufficiently high concentrations.

Comparison of metals concentrations in fish collected in 1988 to the a priori tier levels in table 1 shows that few samples exceeded Tier 2 levels and none exceed Tier 3 levels (table 5). Nickel and thallium both exceeded their respective Tier 2 levels in a few samples but no decisions will be based solely on the nickel and thallium results because the Tier 2 levels and detection limits are so close.

Mercury was found near the Tier 1 level of 0.5 $\mu\text{g/g}$ at Hiwassee River mile 15.0 (0.47 $\mu\text{g/g}$), Hiwassee River mile 83 (0.48 $\mu\text{g/g}$), Nottely River mile 28 (0.44 $\mu\text{g/g}$), and Holston River mile 110 (0.42 $\mu\text{g/g}$). Interestingly, elevated concentrations observed in catfish in 1987 samples from Fontana Reservoir (Little Tennessee River miles 62 and 81) were not observed in 1988. One Hiwassee River site (mile 15) and the Holston River site are part of FT-I and were automatically sampled again in 1989. The other Hiwassee River site (mile 83) and the Nottely River site (mile 28) are both FT-R sites. These sites ordinarily would have been considered for resampling at the screening

level in 1989. However, mercury concentrations of this magnitude appear to be normal for the reservoirs on the Hiwassee River, and as such all the reservoirs should be examined during the same time frame. Rather than repeat sampling on all these reservoirs in 1989 based on concentrations marginally meeting the Tier 2 criterion, they will be resampled in 1990 or 1991.

Selenium concentrations ($1.0 \mu\text{g/g}$) from Ocoee River mile 12 (Parksville Reservoir, an FT-R site) equaled the Tier 2 level of $1.0 \mu\text{g/g}$ indicating a need for further work there. Similar results ($0.83 \mu\text{g/g}$) were found there in 1987. These results, coupled with PCB concentrations (discussed later) and with the historical problems in that reservoir, support a need for a more detailed evaluation of Parksville Reservoir.

Livers from catfish collected as part of the FT-R study are analyzed for metals because this organ typically has higher concentrations of metals than muscle tissue due to its detoxifying role in fish physiology. Once this data base is large enough to determine "normal" concentrations, results will be used as an indicator of environmental contamination. Presence of metals in livers paralleled that in fillets--antimony, beryllium, copper, and silver were not detected in any liver samples, while nickel and thallium were detected in only a few samples at or just above the detection limit (table 6). Chromium, lead, selenium, and zinc were detected in all liver composites, whereas, arsenic, cadmium, and mercury were found in about two-thirds of the samples. Maximum concentrations of lead ($2.7 \mu\text{g/g}$), mercury ($1.0 \mu\text{g/g}$), selenium ($4.1 \mu\text{g/g}$), and zinc ($29 \mu\text{g/g}$) were much

higher than in fillets. Arsenic concentrations were generally higher in fillets than in liver samples. Cadmium concentrations did not show a distinct trend between liver and fillet samples. This is contrary to most monitoring programs which usually report higher concentrations in livers (Moore and Ramamoorthy, 1984).

A comparison of metal concentrations in fillets and livers from fish collected in mainstream Tennessee River reservoirs to fish from tributary reservoirs indicates higher levels of several metals in fish from tributary reservoirs. Of the commonly occurring metals, only arsenic tended to be higher in fish from mainstream reservoirs, whereas, cadmium, mercury, and selenium were higher in fish from tributary reservoirs. There were no distinct differences for chromium, lead, or zinc.

Organics

Table 4 provides results from pesticide and PCB analyses. Several pesticides were not detected in any samples (aldrin and toxaphene) or were detected in only one or two samples at concentrations at or slightly above the detection limit (dieldrin, BHC, and heptachlor). Endrin and endosulfan were also found at only low concentrations (maxima of 0.03 and 0.06 $\mu\text{g/g}$, respectively). Distribution of these two pesticides is interesting because all nine samples containing endrin came from mainstream Tennessee River reservoirs and eight of the ten samples containing endosulfan were from mainstream Tennessee (six) and Cumberland (two) river reservoirs, suggesting a relationship to agricultural activities in the local drainage to those "big river" reservoirs.

Chlordane and DDT_r (sum of all DDT isomers) were the two most commonly encountered pesticides. Occurrence of the two pesticides parallels results from samples collected during the previous year when these were the only pesticides detected. Chlordane was detected in 17 of 48 samples collected in 1988 (compared to 33 of 46 samples in 1987). The maximum chlordane concentration of 0.11 µg/g in the catfish sample from Holston River mile 110 exceeded the Tier 1 level of 0.10 µg/g. No other samples approached that concentration. These results provide additional evidence to those reported above for mercury and the high occurrence of physical anomalies as well as results from the previous two years of sampling that this area of the Holston River needs a thorough evaluation covering both environmental and human health risks associated with toxic substances in the environment.

DDT was found in 23 of the 48 samples, generally more frequently and at higher concentrations in mainstream reservoirs than at other locations. The maximum concentration of DDT_r was 1.2 µg/g (from Wheeler Reservoir), well below the FDA action level of 5.0 µg/g and the Tier 1 level of 2.0 µg/g.

PCBs were found in 26 of the 48 samples. Although PCBs were detected at about the same frequency in 1988 samples as in 1987 samples, concentrations were substantially lower in 1988. For example, concentrations approached or exceeded Tier 2 and 3 levels at 15 sites in 1987 compared to only one site in 1988. It will be interesting to see whether this trend continues in subsequent years. The one location with a PCB concentration exceeding the Tier 1 level of 1.0 µg/g was the FT-R site on Parksville Reservoir (Ocoee River mile 12) with 1.1 µg/g.

These results further support the conclusion that a more detailed evaluation of toxics in Parksville Reservoir is needed.

Table 7 summarizes the highest and second highest levels of contaminants by location and species. Information is presented in this manner to help identify "worst-case" samples for quick comparisons to results from other studies.

RECOMMENDATIONS

Results from 1988 and previous years demonstrate a need to conduct more thorough evaluations of toxics problems in Parksville Reservoir on the Ocoee River and John Sevier Detention pool on the Holston River. Although the need for work on the Holston River was given a high priority in the report on 1987 results (TVA 1989), such a study has yet to be conducted. This area was also recognized in the report on 1986 results as having relatively high concentrations of several toxics (TVA 1988). That report states "The Holston River drains several highly industrialized and urbanized areas which likely account for these high levels of contaminants, especially metals, compared to other sample areas." It would appear that fish from this entire stretch of the Holston River may contain similarly high concentrations of these toxics or that the detention pool serves as a catch basin for materials being carried down the river. Presence of a sports fishery in this pool further supports the need to conduct both environmental and human health risk assessments.

Planning for 1989 fish collections for FT-R was essentially completed at the time this report was prepared. Selection of collection sites was governed by a unique opportunity to evaluate effects of flood

versus drought conditions on contaminant levels in fish. Fish were collected from all mainstem Tennessee River reservoirs in autumn 1988 in various studies. At that time, the Tennessee Valley had been in drought conditions for the previous four years, which had resulted in reduced runoff and low river flows. Heavy rainfall in spring and summer 1989 resulted in periodic flooding and substantially increased flows. Therefore, FT-R efforts for autumn 1989 were directed at examining mainstream reservoirs not being sampled as part of other studies, as well as returning to those FT-R sites where fish had exceeded the Tier 1 level in 1988. Sites for FT-R collections in autumn 1989 are identified in table 8.

REFERENCES

- Food and Drug Administration. 1987. "Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed." Center for Food Safety and Applied Nutrition. Washington, DC.
- Moore, J. W. and S. Ramamoorthy. 1984. Heavy Metals in Natural Waters Springer Series on Environmental Management. R. S. Desanto, Series Editor. Springer-Verlag, New York, Inc., publisher. 268 pp.
- Travis, C. C., F. O. Hoffman, B. G. Baylock, K. L. Daniels, C. S. Gist, and C. W. Weber. 1986. Preliminary Review of TVA Fish Sampling and Analysis Report. Report of Task Group Five. TVA/PUB--86/15. DE86-901129.
- Tennessee Valley Authority. 1988. "Surface Water Monitoring Strategy--Ambient Monitoring--Results from Analyses of Fish Tissue Collected in 1986." Office of Natural Resources and Economic Development, Knoxville, Tennessee.
- Tennessee Valley Authority. 1989a. PCB Studies on Fish from Watts Bar, Fort Loudoun, Tellico, and Chilhowee Reservoirs--1987. TVA/WR/AB--89/10. Water Resources, Chattanooga, Tennessee.
- Tennessee Valley Authority. 1989b. Results of Fish Tissue Screening Studies from Sites in the Tennessee and Cumberland Rivers in 1987. TVA/WR/AB--89/5. Water Resources, Chattanooga, Tennessee.
- Tennessee Valley Authority. 1990. Levels of Selected Metals and PCBs in Channel Catfish from Chickamauga Reservoir--1987." TVA/WR/AB--90/3. Water Resources, Chattanooga, Tennessee.

FIGURE

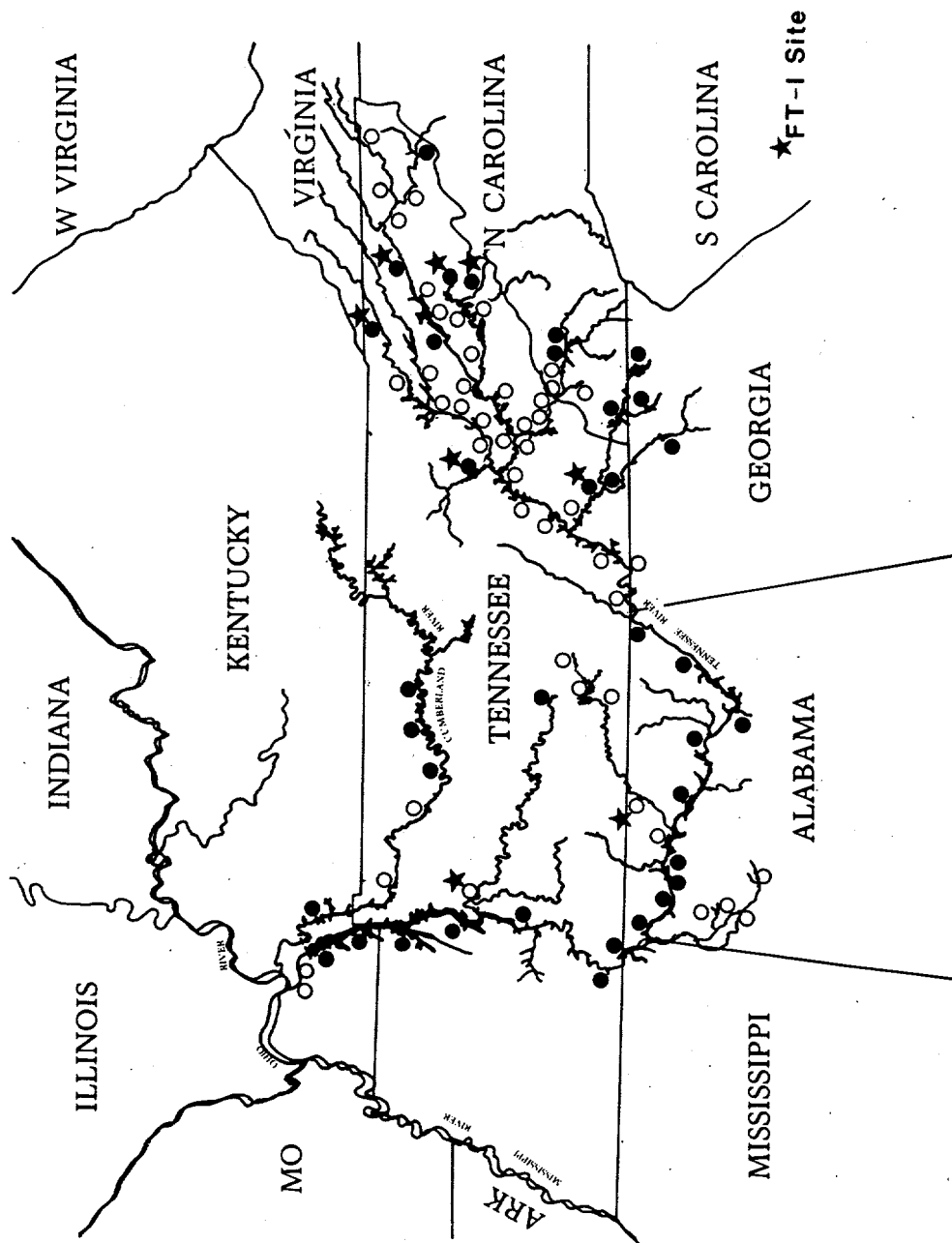


Figure 1. Filled circles identify sites where fish were collected as part of TVA screening studies in 1988.

TABLES

Table 1. Contaminant Levels^a Used to Make Recommendations Based on Analytical Results from Valley-Wide Fish Tissue Screening Study

Parameter	Laboratory Detection Limit (µg/g)	Tier 1	Tier 2	Tier 3
		Return to Rotation System (µg/g)	Resample at Screening Level Following Year (µg/g)	Recommend Intensive Study (µg/g)
Antimony	2.0	< 5.0	≥ 5.0	b
Arsenic	0.03	< 0.5	≥ 0.5	≥ 0.7
Beryllium	0.02	< 0.1	≥ 0.1	≥ 0.3
Cadmium	0.001	< 0.5	≥ 0.5	≥ 1.0
Chromium	0.02	< 0.7	≥ 0.7 ^c	≥ 1.5 ^c
Copper	0.2	< 3.0	≥ 3.0	b
Lead	0.2	< 1.5	≥ 1.5	≥ 2.0
Mercury	0.1	< 0.5	≥ 0.5	≥ 0.7
Nickel	1.0	< 2.0	≥ 2.0 ^c	≥ 4.0 ^c
Selenium	0.02	< 1.0	≥ 1.0	≥ 3.0
Silver	0.2	< 12.0	≥ 12.0	b
Thallium	1.0	< 1.0	≥ 1.0	≥ 3.0
Zinc	0.1	< 75.0	≥ 75.0	b
Aldrin	0.01	< 0.1	≥ 0.1	≥ 0.2
Benzene Hexachloride	0.01	< 0.1	≥ 0.1	≥ 0.2
Chlordane	0.01	< 0.1	≥ 0.1	≥ 0.2
DDT	0.01	< 2.0	≥ 2.0	≥ 4.0
Dieldrin	0.01	< 0.1	≥ 0.1	≥ 0.2
Endosulfan	0.01	< 3.0	≥ 3.0	≥ 5.0
Endrin	0.01	< 0.1	≥ 0.1	≥ 0.2
Heptachlor	0.01	< 0.1	≥ 0.1	≥ 0.2
Toxaphene	0.5	< 2.0	≥ 2.0	≥ 3.0
PCB's	0.1	< 1.0	≥ 1.0	≥ 1.5

- a. These levels will be used as a general guide. Specific recommendations will be made on a case-by-case basis.
- b. Selection of a level of this metal which would result in a recommendation to conduct intensive studies cannot be made at this time.
- c. Chromium and nickel frequently occur as a result of laboratory contamination from the blending process. A suspected source would have to exist before further examination would be recommended based only on these metals.

Table 2. Physical Information Specific to Each Fish Collected
for Tissue Analysis from Inflow and Reservoir Locations

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Kentucky Reservoir						
Tennessee River mile 28.0	12/15/88	CHC	F	2714	375	528
Tennessee River mile 28.0	12/15/88	CHC	F	2714	674	3,245
Tennessee River mile 28.0	12/15/88	CHC	F	2714	565	2,030
Tennessee River mile 28.0	12/15/88	CHC	M	2714	600	2,390
Tennessee River mile 28.0	12/15/88	CHC	M	2714	613	2,400
Tennessee River mile 61.0	12/07/88	CHC	F	2712	489	1,094
Tennessee River mile 61.0	12/07/88	CHC	F	2712	567	1,985
Tennessee River mile 61.0	12/07/88	CHC	F	2712	610	3,005
Tennessee River mile 61.0	12/07/88	CHC	M	2712	549	1,885
Tennessee River mile 61.0	12/07/88	CHC	M	2712	570	2,180
Big Sandy River mile 4.0	12/16/88	CHC	F	2713	603	2,114
Big Sandy River mile 4.0	12/16/88	CHC	F	2713	594	2,715
Big Sandy River mile 4.0	12/16/88	CHC	F	2713	580	2,376
Big Sandy River mile 4.0	12/16/88	CHC	F	2713	461	1,062
Big Sandy River mile 4.0	12/16/88	CHC	M	2713	550	1,810
Tennessee River mile 97.0	12/07/88	CHC	F	2716	594	3,350
Tennessee River mile 97.0	12/07/88	CHC	F	2716	453	1,018
Tennessee River mile 97.0	12/07/88	CHC	M	2716	620	2,645
Tennessee River mile 97.0	12/07/88	CHC	M	2716	610	2,680
Tennessee River mile 97.0	12/07/88	CHC	M	2716	639	3,465
Tennessee River mile 172.3	01/23/89	CHC	F	2711	496	1,196
Tennessee River mile 172.3	01/23/89	CHC	F	2711	430	798
Tennessee River mile 172.3	01/23/89	CHC	F	2711	462	1,046
Tennessee River mile 172.3	01/23/89	CHC	M	2711	520	1,505
Tennessee River mile 172.3	01/23/89	CHC	M	2711	422	662
Tennessee River mile 204.0	12/13/88	CHC	F	2709	341	338
Tennessee River mile 204.0	12/13/88	CHC	F	2709	469	888
Tennessee River mile 204.0	12/13/88	CHC	F	2709	439	730
Tennessee River mile 204.0	12/13/88	CHC	M	2709	430	718
Tennessee River mile 204.0	12/13/88	CHC	M	2709	593	1,580
Pickwick Reservoir						
Tennessee River mile 210.0	11/08/88	CHC	F	2705	443	772
Tennessee River mile 210.0	11/08/88	CHC	F	2705	462	962
Tennessee River mile 210.0	11/08/88	CHC	M	2705	469	944
Tennessee River mile 210.0	11/08/88	CHC	M	2705	459	896
Tennessee River mile 210.0	11/08/88	CHC	M	2705	398	538
Tennessee River mile 235.0	11/08/88	CHC	F	2704	443	822
Tennessee River mile 235.0	11/08/88	CHC	F	2704	460	996
Tennessee River mile 235.0	11/08/88	CHC	F	2704	376	526
Tennessee River mile 235.0	11/08/88	CHC	M	2704	490	956
Tennessee River mile 235.0	11/08/88	CHC	M	2704	475	1,096
Tennessee River mile 255.0	10/27/88	CHC	F	2706	405	646
Tennessee River mile 255.0	10/27/88	CHC	F	2706	422	798
Tennessee River mile 255.0	10/27/88	CHC	F	2706	422	732
Tennessee River mile 255.0	10/27/88	CHC	F	2706	390	676
Tennessee River mile 255.0	10/27/88	CHC	M	2706	430	670

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Wilson Reservoir						
Tennessee River mile 260.0	10/25/88	CHC	F	2715	455	838
Tennessee River mile 260.0	10/25/88	CHC	F	2715	390	486
Tennessee River mile 260.0	10/25/88	CHC	F	2715	375	474
Tennessee River mile 260.0	10/25/88	CHC	F	2715	350	316
Tennessee River mile 260.0	10/25/88	CHC	M	2715	520	1,358
Tennessee River mile 270.0	10/25/88	CHC	F	2717	390	498
Tennessee River mile 270.0	10/25/88	CHC	F	2717	391	470
Tennessee River mile 270.0	10/25/88	CHC	F	2717	362	428
Tennessee River mile 270.0	10/25/88	CHC	M	2717	430	692
Tennessee River mile 270.0	10/25/88	CHC	M	2717	456	894
Wheeler Reservoir						
Tennessee River mile 300.0	11/16/88	CHC	F	2710	401	634
Tennessee River mile 300.0	11/16/88	CHC	F	2710	442	910
Tennessee River mile 300.0	11/16/88	CHC	F	2710	439	948
Tennessee River mile 300.0	11/16/88	CHC	M	2710	465	996
Tennessee River mile 300.0	11/16/88	CHC	M	2710	431	902
Tennessee River mile 339.0	11/16/88	CHC	F	2708	410	632
Tennessee River mile 339.0	11/16/88	CHC	F	2708	510	1,390
Tennessee River mile 339.0	11/16/88	CHC	F	2708	492	1,285
Tennessee River mile 339.0	11/16/88	CHC	M	2708	481	1,218
Tennessee River mile 339.0	11/16/88	CHC	M	2708	521	1,465
Guntersville Reservoir						
Tennessee River mile 350.0	11/18/88	CHC	F	2707	250	138
Tennessee River mile 350.0	11/18/88	CHC	F	2707	358	396
Tennessee River mile 350.0	11/18/88	CHC	F	2707	364	420
Tennessee River mile 350.0	11/18/88	CHC	F	2707	325	338
Tennessee River mile 350.0	11/18/88	CHC	M	2707	523	1,535
Tennessee River mile 382.0	11/23/88	CHC	F	2702	564	1,900
Tennessee River mile 382.0	11/23/88	CHC	F	2702	302	180
Tennessee River mile 382.0	11/23/88	CHC	F	2702	367	524
Tennessee River mile 382.0	11/23/88	CHC	F	2702	454	906
Tennessee River mile 382.0	11/23/88	CHC	M	2702	322	358
Tennessee River mile 415.0	11/29/88	CHC	F	2703	606	2,855
Tennessee River mile 415.0	11/29/88	CHC	F	2703	421	1,500
Tennessee River mile 415.0	11/29/88	CHC	F	2703	550	1,980
Tennessee River mile 415.0	11/29/88	CHC	F	2703	380	512
Tennessee River mile 415.0	11/29/88	CHC	M	2703	549	1,925
Normandy Reservoir						
Duck River mile 251.2	11/02/88	CHC	F	3372	679	3,270
Duck River mile 251.2	11/02/88	CHC	F	3372	651	2,240
Duck River mile 251.2	11/02/88	CHC	F	3372	642	2,570
Duck River mile 251.2	11/02/88	CHC	M	3372	431	750
Duck River mile 251.2	11/02/88	CHC	M	3372	696	3,875

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Chickamauga Reservoir						
Hiwassee River mile 14.7	07/21/88	CHC	F	3774	453	862
Hiwassee River mile 14.7	07/22/88	CHC	F	3774	484	1,023
Hiwassee River mile 14.7	07/21/88	CHC	F	3774	493	1,090
Hiwassee River mile 14.7	07/21/88	CHC	M	3774	501	1,224
Hiwassee River mile 14.7	07/22/88	CHC	M	3774	460	895
Hiwassee River mile 14.7	07/26/88	LMB	M	3775	407	877
Hiwassee River mile 14.7	07/26/88	LMB	F	3775	357	576
Hiwassee River mile 14.7	07/22/88	LMB	M	3775	388	780
Hiwassee River mile 14.7	07/26/88	LMB	M	3775	452	1,080
Hiwassee River mile 14.7	07/26/88	LMB	M	3775	345	495
Hiwassee River mile 14.7	08/05/88	SBU	F	3776	392	957
Hiwassee River mile 14.7	08/05/88	SBU	F	3776	406	1,036
Hiwassee River mile 14.7	08/05/88	SBU	F	3776	338	532
Hiwassee River mile 14.7	08/05/88	SBU	F	3776	454	1,462
Hiwassee River mile 14.7	08/05/88	SBU	F	3776	420	1,131
Hiwassee Reservoir						
Hiwassee River mile 83.0	11/15/88	CHC	F	3374	558	1,525
Hiwassee River mile 83.0	11/15/88	CHC	F	3374	532	1,369
Hiwassee River mile 83.0	11/15/88	CHC	F	3374	490	1,092
Hiwassee River mile 83.0	11/15/88	CHC	F	3374	520	1,065
Hiwassee River mile 83.0	11/15/88	CHC	F	3374	494	971
Chatuge Reservoir						
Hiwassee River mile 123.0	11/10/88	CHC	F	3377	685	1,980
Hiwassee River mile 123.0	11/10/88	CHC	F	3377	515	1,075
Hiwassee River mile 123.0	11/10/88	CHC	F	3377	522	1,165
Hiwassee River mile 123.0	11/10/88	CHC	M	3377	695	3,410
Hiwassee River mile 123.0	11/10/88	CHC	M	3377	630	2,340
Parksville Reservoir						
Ocoee River mile 12.0	11/22/88	CHC	F	3383	501	1,170
Ocoee River mile 12.0	11/22/88	CHC	F	3383	464	822
Ocoee River mile 12.0	11/22/88	CHC	F	3383	442	741
Ocoee River mile 12.0	11/22/88	CHC	F	3383	488	1,003
Ocoee River mile 12.0	11/22/88	CHC	F	3383	465	762
Blue Ridge Reservoir						
Toccoa River mile 56.8	10/26/88	CHC	F	3384	493	1,057
Toccoa River mile 56.8	10/26/88	CHC	F	3384	385	567
Toccoa River mile 56.8	10/26/88	CHC	M	3384	460	876
Toccoa River mile 56.8	10/26/88	CHC	M	3384	334	287

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Nottely Reservoir						
Nottely River mile 27.5	11/09/88	CHC	F	3373	493	1,020
Nottely River mile 27.5	11/09/88	CHC	F	3373	520	1,139
Nottely River mile 27.5	11/09/88	CHC	F	3373	437	619
Nottely River mile 27.5	12/06/88	CHC	F	3373	374	440
Nottely River mile 27.5	12/06/88	CHC	M	3373	550	1,530
Watts Bar Reservoir						
Emory River mile 7.5	08/02/88	LMB	F	3763	454	1,395
Emory River mile 7.5	08/02/88	LMB	F	3763	451	1,374
Emory River mile 7.5	08/02/88	LMB	F	3763	368	685
Emory River mile 7.5	08/02/88	LMB	F	3763	295	317
Emory River mile 7.5	08/02/88	LMB	M	3763	307	326
Emory River mile 7.5	08/02/88	CHC	F	3764	457	898
Emory River mile 7.5	08/02/88	CHC	F	3764	446	774
Emory River mile 7.5	08/02/88	CHC	F	3764	388	463
Emory River mile 7.5	08/02/88	CHC	M	3764	458	813
Emory River mile 7.5	08/02/88	CHC	M	3764	390	468
Emory River mile 7.5	08/02/88	C	F	3765	629	2,710
Emory River mile 7.5	08/02/88	C	F	3765	639	3,522
Emory River mile 7.5	08/02/88	C	F	3765	480	1,828
Emory River mile 7.5	08/02/88	C	M	3765	505	1,703
Emory River mile 7.5	08/02/88	C	M	3765	452	1,321
Powell River						
Powell River mile 65.3	05/25/88	SPB	F	3757	296	429
Powell River mile 65.3	05/25/88	SPB	F	3757	287	357
Powell River mile 65.3	05/25/88	SPB	F	3757	342	627
Powell River mile 65.3	05/25/88	SPB	M	3757	313	467
Powell River mile 65.3	05/25/88	SPB	U	3757	228	166
Powell River mile 65.3	05/25/88	DRM	F	3758	407	958
Powell River mile 65.3	05/25/88	DRM	M	3758	358	592
Powell River mile 65.3	05/25/88	DRM	M	3758	345	417
Powell River mile 65.3	05/25/88	DRM	M	3758	358	513
Powell River mile 65.3	05/25/88	DRM	U	3758	358	562
Powell River mile 65.3	05/25/88	CHC	F	3759	365	585
Powell River mile 65.3	05/25/88	CHC	F	3759	420	744
Powell River mile 65.3	05/25/88	CHC	M	3759	473	1,079
Powell River mile 65.3	05/25/88	CHC	M	3759	367	537
Powell River mile 65.3	05/25/88	CHC	U	3759	402	586

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Fontana Reservoir						
L. Tennessee River mile 62.5	11/25/88	CHC	F	3381	486	1,007
L. Tennessee River mile 62.5	11/25/88	CHC	F	3381	450	733
L. Tennessee River mile 62.5	11/25/88	CHC	F	3381	436	556
L. Tennessee River mile 62.5	11/25/88	CHC	M	3381	402	444
L. Tennessee River mile 62.5	11/25/88	CHC	M	3381	386	433
L. Tennessee River mile 81.0	11/25/88	CHC	F	3380	356	369
L. Tennessee River mile 81.0	11/25/88	CHC	F	3380	393	429
L. Tennessee River mile 81.0	11/25/88	CHC	F	3380	371	400
L. Tennessee River mile 81.0	11/25/88	CHC	M	3380	406	593
L. Tennessee River mile 81.0	11/25/88	CHC	M	3380	404	449
French Broad River						
French Broad River mile 71.4	11/23/88	C	F	3771	497	1,609
French Broad River mile 71.4	11/23/88	C	F	3771	542	2,209
French Broad River mile 71.4	11/23/88	C	M	3771	487	1,419
French Broad River mile 71.4	11/23/88	C	M	3771	493	1,686
French Broad River mile 71.4	11/23/88	C	M	3771	493	1,611
French Broad River mile 71.4	11/23/88	CHC	F	3772	555	1,360
French Broad River mile 71.4	11/23/88	CHC	F	3772	372	360
French Broad River mile 71.4	11/23/88	CHC	M	3772	522	1,284
French Broad River mile 71.4	11/23/88	CHC	M	3772	324	245
French Broad River mile 71.4	11/23/88	CHC	M	3772	382	401
French Broad River mile 71.4	11/23/88	LMB	F	3773	301	391
French Broad River mile 71.4	11/23/88	LMB	F	3773	292	300
French Broad River mile 71.4	11/23/88	LMB	F	3773	421	1,272
French Broad River mile 71.4	11/23/88	LMB	F	3773	395	1,051
French Broad River mile 71.4	11/23/88	LMB	M	3773	510	2,445
Nolichucky River						
Nolichucky River mile 5.3	11/23/88	CPY	M	3760	240	183
Nolichucky River mile 5.3	11/23/88	LMB	F	3760	394	840
Nolichucky River mile 5.3	11/23/88	SMB	F	3760	262	232
Nolichucky River mile 5.3	11/23/88	SPB	F	3760	263	236
Nolichucky River mile 5.3	11/23/88	SPB	U	3760	231	125
Nolichucky River mile 5.3	11/23/88	CHC	F	3761	381	504
Nolichucky River mile 5.3	11/23/88	CHC	F	3761	317	231
Nolichucky River mile 5.3	11/23/88	CHC	F	3761	395	562
Nolichucky River mile 5.3	11/23/88	CHC	F	3761	320	231
Nolichucky River mile 5.3	11/23/88	CHC	M	3761	471	838
Nolichucky River mile 5.3	11/23/88	C	F	3762	591	2,798
Nolichucky River mile 5.3	11/23/88	C	F	3762	570	2,341
Nolichucky River mile 5.3	11/23/88	C	M	3762	525	1,994
Nolichucky River mile 5.3	11/23/88	C	M	3762	505	1,695
Nolichucky River mile 5.3	11/23/88	C	M	3762	525	1,821

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Cherokee River						
Holston River mile 53.0	12/06/88	FHC	F	3433	856	8,470
Holston River mile 53.0	12/06/88	FHC	F	3433	740	5,765
Holston River mile 53.0	12/01/88	FHC	F	3433	701	4,569
Holston River mile 53.0	12/01/88	FHC	M	3433	764	7,149
Holston River mile 53.0	12/06/88	FHC	M	3433	752	5,350
Holston River						
Holston River mile 109.9	06/07/88	BLC	F	3754	601	2,568
Holston River mile 109.9	06/07/88	BLC	M	3754	623	2,858
Holston River mile 109.9	06/07/88	CHC	F	3754	506	1,159
Holston River mile 109.9	06/07/88	CHC	M	3754	554	1,759
Holston River mile 109.9	06/07/88	LMB	F	3755	463	1,938
Holston River mile 109.9	06/07/88	LMB	F	3755	434	1,484
Holston River mile 109.9	06/07/88	LMB	F	3755	446	1,488
Holston River mile 109.9	06/07/88	LMB	M	3755	390	832
Holston River mile 109.9	06/07/88	LMB	M	3755	305	429
Holston River mile 109.9	06/07/88	C	F	3756	669	4,900
Holston River mile 109.9	06/07/88	C	F	3756	601	2,633
Holston River mile 109.9	06/07/88	C	F	3756	598	2,715
Holston River mile 109.9	06/07/88	C	M	3756	535	1,831
Holston River mile 109.9	06/07/88	C	M	3756	466	1,197
Watauga Reservoir						
Watauga River mile 48.0	10/18/88	CHC	F	3382	436	870
Watauga River mile 48.0	10/18/88	CHC	F	3382	515	1,555
Watauga River mile 48.0	10/18/88	CHC	M	3382	554	1,163
Watauga River mile 48.0	10/18/88	CHC	M	3382	568	1,430
Watauga River mile 48.0	10/18/88	CHC	M	3382	480	955
Barkley Reservoir						
Cumberland River mile 59.0	12/01/88	CHC	F	3379	415	552
Cumberland River mile 59.0	12/01/88	CHC	F	3379	384	410
Cumberland River mile 59.0	12/01/88	CHC	F	3379	420	604
Cumberland River mile 59.0	12/01/88	CHC	F	3379	421	556
Cumberland River mile 59.0	12/01/88	CHC	M	3379	436	836
Cheatham Reservoir						
Cumberland River mile 176.0	12/12/88	CHC	F	3378	482	1,066
Cumberland River mile 176.0	12/12/88	CHC	F	3378	414	608
Cumberland River mile 176.0	12/12/88	CHC	F	3378	334	292
Cumberland River mile 176.0	12/12/88	CHC	M	3378	407	496
Cumberland River mile 176.0	12/12/88	CHC	M	3378	359	347

Table 2 (Continued)

Collection site	Date	Species ^a	Sex ^b	LABID ^c	Length (mm)	Weight (g)
Old Hickory Reservoir						
Cumberland River mile 217.0	12/21/88	CHC	F	3375	458	744
Cumberland River mile 217.0	12/21/88	CHC	M	3375	367	368
Cumberland River mile 217.0	12/21/88	CHC	M	3375	340	340
Cumberland River mile 217.0	12/21/88	CHC	M	3375	428	600
Cumberland River mile 217.0	12/21/88	CHC	M	3375	287	184
Cumberland River mile 236.0	12/01/88	CHC	F	3376	438	686
Cumberland River mile 236.0	12/01/88	CHC	F	3376	435	649
Cumberland River mile 236.0	12/01/88	CHC	F	3376	373	447
Cumberland River mile 236.0	12/01/88	CHC	F	3376	394	482
Cumberland River mile 236.0	12/01/88	CHC	M	3376	392	451

a. Species abbreviations: CHC = channel catfish; BLC = blue catfish; FHC = flathead catfish; LMB = largemouth bass; SMB = smallmouth bass; SPB = spotted bass; C = carp; CPY = crappie; DRM = drum; SBU = smallmouth buffalo.

b. F = female; M = male; U = undetermined.

c. The LABID (laboratory identification) number is the mechanism used to relate physical information in table 2 to information on tissue levels of metals in table 3 and organics in table 4. Fish with the same LABID number in this table were composited for laboratory analysis.

Table 3. Concentrations (µg/g) of Metals in Compositied Fish Flesh Samples from Inflow and Reservoir Locations

Collection Site	Species ^a	LABID	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Kentucky Reservoir															
Tennessee River mile 28.0	CHC	2714	2.00K ^b	0.08	0.02K	0.10	0.06	2.00K	0.06	0.14	1.00K	0.11	0.10K	2.00	5.20
Tennessee River mile 61.0	CHC	2712	2.00K	0.10	0.02K	0.04	0.05	2.00K	0.07	0.10K	1.00K	0.10	0.10K	1.00K	5.20
Big Sandy River mile 4.0	CHC	2713	2.00K	0.08	0.02K	0.02K	0.03	2.00K	0.03	0.10K	1.00K	0.13	0.10K	1.00K	5.20
Tennessee River mile 97.0	CHC	2716	2.00K	0.16	0.02K	0.02K	0.03	2.00K	0.02	0.10K	1.00K	0.15	0.10K	4.00	5.20
Tennessee River mile 172.3	CHC	2711	2.00K	0.15	0.02K	0.02K	0.04	2.00K	0.13	0.10K	1.00K	0.12	0.10K	1.00K	5.80
Tennessee River mile 204.0	CHC	2709	2.00K	0.04	0.02K	0.02K	0.03	2.00K	0.06	0.15	1.00K	0.13	0.10K	1.00K	6.20
Pickwick Reservoir															
Tennessee River mile 210.0	CHC	2705	2.00K	0.28	0.02K	0.12	0.04	2.00K	0.10	0.10K	1.00K	0.13	0.10K	1.00K	6.60
Tennessee River mile 235.0	CHC	2704	2.00K	0.13	0.02K	0.02K	0.03	2.00K	0.04	0.10K	1.00K	0.12	0.10K	1.00K	5.60
Tennessee River mile 255.0	CHC	2706	2.00K	0.03	0.02K	0.02K	0.12	2.00K	0.10	0.11	1.00K	0.13	0.10K	1.00K	6.40
Wilson Reservoir															
Tennessee River mile 260.0	CHC	2715	2.00K	0.09	0.02K	0.02K	0.05	2.00K	0.03	0.10K	1.00K	0.11	0.10K	1.00	4.60
Tennessee River mile 270.0	CHC	2717	2.00K	0.17	0.02K	0.02K	0.02K	2.00K	0.05	0.10K	1.00K	0.14	0.10K	1.00K	5.80
Wheeler Reservoir															
Tennessee River mile 300.0	CHC	2710	2.00K	0.05	0.02K	0.02K	0.03	2.00K	0.06	0.10K	1.00K	0.12	0.10K	1.00K	7.20
Tennessee River mile 339.0	CHC	2708	2.00K	0.18	0.02K	0.02K	0.04	2.00K	0.05	0.10K	1.00K	0.12	0.10K	1.00	6.40
Guntersville Reservoir															
Tennessee River mile 350.0	CHC	2707	2.00K	0.12	0.02K	0.02K	0.02	2.00K	0.06	0.10K	1.00K	0.16	0.10K	1.00K	7.40
Tennessee River mile 382.0	CHC	2702	2.00K	0.10	0.02K	0.02K	0.09	2.00K	0.04	0.10K	1.00K	0.16	0.10K	1.00K	6.00
Tennessee River mile 415.0	CHC	2703	2.00K	0.13	0.02K	0.02K	0.03	2.00K	0.03	0.10K	1.00K	0.14	0.10K	1.00K	5.00
Normandy Reservoir															
Duck River mile 251.2	CHC	3372	2.00K	0.06	0.02K	0.16	0.04	2.00K	0.05	0.30	1.00	0.10	0.10K	1.00K	8.00

Table 3 (Continued)

Collection Site	Species ^a	LABID	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Chickamauga Reservoir															
Hiwassee River mile 14.7	CHC	3774	2.00K	0.05	0.02K	0.10	0.02K	2.00K	0.11	0.12	1.00K	0.10	0.10K	1.00K	7.00
Hiwassee River mile 14.7	LMB	3775	2.00K	0.05	0.02K	0.12	0.02K	2.00K	0.08	0.47	1.00K	0.02	0.10K	1.00K	9.40
Hiwassee River mile 14.7	SBU	3776	2.00K	0.04	0.02K	0.02K	0.02	2.00K	0.07	0.10K	1.00K	0.16	0.10K	4.00	8.20
Hiwassee Reservoir															
Hiwassee River mile 83.0	CHC	3374	2.00K	0.03	0.02K	0.16	0.02K	2.00K	0.05	0.48	2.00	0.18	0.10K	1.00K	7.00
Chatuge Reservoir															
Hiwassee River mile 123.0	CHC	3377	2.00K	0.03	0.02K	0.16	0.02K	2.00K	0.06	0.30	1.00K	0.23	0.10K	1.00	6.00
Parksville Reservoir															
Ocoee River mile 12.0	CHC	3383	2.00K	0.03	0.02K	0.02K	0.02K	2.00K	0.10	0.10K	1.00K	1.00	0.10K	1.00K	6.00
Blue Ridge Reservoir															
Toccoa River mile 56.8	CHC	3384	2.00K	0.02K	0.02K	0.24	0.02K	2.00K	0.08	0.13	1.00	0.30	0.10K	1.00K	6.60
Nottely Reservoir															
Nottely River mile 27.5	CHC	3373	2.00K	0.04	0.02K	0.12	0.04	2.00K	0.07	0.44	1.00K	0.15	0.10K	1.00K	7.00
Watts Bar Reservoir															
Emory River mile 7.5	LMB	3763	2.00K	0.10	0.02K	0.02K	0.07	2.00K	0.41	0.20	1.00K	0.17	0.10K	1.00K	8.60
Emory River mile 7.5	CHC	3764	2.00K	0.03	0.04	0.02K	0.03	2.00K	0.09	0.22	1.00K	0.14	0.10K	1.00K	10.00
Emory River mile 7.5	C	3765	2.00K	0.03	0.02K	0.02K	0.06	2.00K	0.40	0.14	1.00K	0.33	0.10K	1.00K	13.00
Powell River															
Powell River mile 65.3	SPB	3757	2.00K	0.07	0.02K	0.42	0.03	2.00K	0.62	0.24	1.00K	0.50	0.10K	1.00K	12.00
Powell River mile 65.3	DRM	3758	2.00K	0.04	0.02K	0.22	0.02	2.00K	0.62	0.16	1.00K	0.72	0.10K	2.00	7.40
Powell River mile 65.3	CHC	3759	2.00K	0.02K	0.02K	0.02K	0.02	2.00K	0.07	0.13	1.00K	0.36	0.10K	1.00K	7.60

Table 3 (Continued)

Collection Site	Species ^a	LABID	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Fontana Reservoir															
L. Tennessee River mile 62.5	CHC	3381	2.00K	0.02K	0.02K	0.24	0.02	2.00K	0.05	0.29	1.00K	0.13	0.10K	1.00K	7.00
L. Tennessee River mile 81.0	CHC	3380	2.00K	0.04	0.02K	0.02K	0.02	2.00K	0.07	0.26	1.00	0.12	0.10K	1.00K	7.00
French Broad River															
French Broad River mile 71.4	C	3771	2.00K	0.02K	0.02K	0.32	0.05	2.00K	0.20	0.14	1.00K	0.15	0.10K	1.00K	19.00
French Broad River mile 71.4	CHC	3772	2.00K	0.03	0.02K	0.16	0.08	2.00K	0.50	0.12	1.00K	0.06	0.10K	2.00	7.80
French Broad River mile 71.4	LMB	3773	2.00K	0.09	0.02K	0.36	0.03	2.00K	0.05	0.20	1.00K	0.08	0.10K	1.00K	9.60
Nolichucky River															
Nolichucky River mile 5.3	Bass	3760	2.00K	0.05	0.02K	0.02K	0.05	2.00K	0.14	0.18	1.00K	0.12	0.10K	1.00K	13.00
Nolichucky River mile 5.3	CHC	3761	2.00K	0.02K	0.02K	0.02K	0.07	2.00K	0.13	0.10K	1.00K	0.05	0.10K	2.00	7.80
Nolichucky River mile 5.3	C	3762	2.00K	0.05	0.02K	0.02K	0.04	2.00K	0.38	0.12	1.00K	0.16	0.10K	1.00K	23.00
Cherokee River															
Holston River mile 53.0	FHC	3433	2.00K	0.06	0.02K	0.06	0.05	2.00K	0.20	0.31	1.00K	0.26	0.10K	1.00K	5.40
Holston River															
Holston River mile 109.9	CAT	3754	2.00K	0.02K	0.02K	0.02K	0.04	2.00K	0.07	0.14	1.00	0.25	0.10K	1.00K	8.40
Holston River mile 109.9	LMB	3755	2.00K	0.07	0.02K	0.02K	0.06	2.00K	0.14	0.42	1.00K	0.26	0.10K	2.00	7.20
Holston River mile 109.9	CAT	3756	2.00K	0.02K	0.02K	0.02K	0.02	2.00K	0.52	0.24	1.00K	0.23	0.10K	1.00K	18.00
Watauga Reservoir															
Watauga River mile 48.0	CHC	3382	2.00K	0.06	0.02K	0.18	0.03	2.00K	0.04	0.16	1.00K	0.13	0.10K	2.00	8.00
Barkley Reservoir															
Cumberland River mile 59.0	CHC	3379	2.00K	0.03	0.02K	0.12	0.02K	2.00K	0.06	0.10K	1.00K	0.16	0.10K	1.00K	5.40
Cheatham Reservoir															
Cumberland River mile 176.0	CHC	3378	2.00K	0.04	0.02K	0.12	0.02K	2.00K	0.07	0.10K	1.00K	0.10	0.10K	1.00K	6.20

Table 3 (Continued)

Collection Site	Species ^a	LABID	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Old Hickory Reservoir															
Cumberland River mile 217.0	CHC	3375	2.00K	0.04	0.02K	0.18	0.05	2.00K	0.11	0.10K	1.00K	0.13	0.10K	3.00	7.80
Cumberland River mile 236.0	CHC	3376	2.00K	0.06	0.02K	0.20	0.05	2.00K	0.11	0.10K	1.00K	0.12	0.10K	1.00K	7.80

a. Species abbreviations: CHC = channel catfish; BLC = blue catfish; FHC = flathead catfish; LMB = largemouth bass; SMB = smallmouth bass; SPB = spotted bass; C = carp; DRM = drum; SBU = smallmouth buffalo.

b. K--used to signify less than detection level identified.

Table 4. Concentrations (µg/g) of Pesticides and PCBs in Composited Fish Flesh Samples from Inflow and Reservoir Locations

Collection Site	Species ^a	LABID	Lipid (%)	Benzene			DDTr	Endo-sulfan	Endrin	Hepta-chlor	PCBs
				Hexachlo	Chlordane	Toxophene					
Kentucky Reservoir											
Tennessee River mile 28.0	CHC	2714	9.80	0.01K ^b	0.01K	0.50K	0.33	0.01K	1.01K	0.01K	0.27
Tennessee River mile 61.0	CHC	2712	13.00	0.01K	0.01K	0.50K	0.26	0.03	0.01K	0.01K	0.36
Big Sandy River mile 4.0	CHC	2713	12.00	0.01K	0.01K	0.50K	0.30	0.03	0.01K	0.01K	0.16
Tennessee River mile 97.0	CHC	2716	12.00	0.01K	0.01K	0.50K	0.36	0.02	0.01K	0.01K	0.13
Tennessee River mile 172.3	CHC	2711	12.00	0.01K	0.01K	0.50K	0.46	0.02	0.01K	0.01K	0.15
Tennessee River mile 204.0	CHC	2709	2.40	0.01K	0.01K	0.50K	0.01K	0.02	0.01K	0.01K	0.10K
Pickwick Reservoir											
Tennessee River mile 210.0	CHC	2705	11.00	0.01K	0.01K	0.50K	0.01K	0.01K	0.01	0.01K	0.17
Tennessee River mile 235.0	CHC	2704	9.30	0.01K	0.02	0.50K	0.05	0.01K	0.01	0.01	0.16
Tennessee River mile 255.0	CHC	2706	6.30	0.01K	0.02	0.50K	0.05	0.01K	0.01	0.01	0.17
Wilson Reservoir											
Tennessee River mile 260.0	CHC	2715	3.90	0.01K	0.01K	0.50K	0.26	0.01K	0.01K	0.01K	0.10K
Tennessee River mile 270.0	CHC	2717	8.10	0.01K	0.02	0.50K	0.60	0.01K	0.01	0.01K	0.10K
Wheeler Reservoir											
Tennessee River mile 300.0	CHC	2710	12.00	0.01K	0.01K	0.50K	1.22	0.01K	0.01	0.01K	0.29
Tennessee River mile 339.0	CHC	2708	11.00	0.01K	0.02	0.50K	1.00	0.01K	0.02	0.01K	0.74
Guntersville Reservoir											
Tennessee River mile 350.0	CHC	2707	3.80	0.01K	0.02	0.50K	0.09	0.01K	0.01	0.01	0.65
Tennessee River mile 382.0	CHC	2702	5.30	0.01K	0.02	0.50K	0.06	0.01K	0.01	0.01K	0.37
Tennessee River mile 415.0	CHC	2703	3.50	0.01K	0.04	0.50K	0.08	0.01K	0.03	0.01K	0.59
Normandy Reservoir											
Duck River mile 251.2	CHC	3372	3.00	0.01K	0.01K	0.50K	0.05	0.01K	0.01K	0.01K	0.10K

Table 4 (Continued)

Collection Site	Species ^a	LABID	Lipid (%)	Aldrin	Dieldrin	Toxophene	Benzene Hexachlo	Chlordane	DDTr	Endo-sulfan	Endrin	Hepta-chlor	PCBs
Chickamauga Reservoir													
Hiwassee River mile 14.7	CHC	3774	4.90	0.01K	0.01K	0.50K	0.01K	0.01	0.01K	0.01K	0.01K	0.01K	0.13
Hiwassee River mile 14.7	LMB	3775	0.30	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Hiwassee River mile 14.7	SBU	3776	6.70	0.01K	0.01K	0.50K	0.01K	0.01	0.01K	0.01K	0.01K	0.01	0.10K
Hiwassee Reservoir													
Hiwassee River mile 83.0	CHC	3374	3.10	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Chatuge Reservoir													
Hiwassee River mile 123.0	CHC	3377	2.30	0.01K	0.01K	0.50K	0.01K	0.01K	0.03	0.01K	0.01K	0.01K	0.10K
Parksville Reservoir													
Ocoee River mile 12.0	CHC	3383	2.90	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	1.10
Blue Ridge Reservoir													
Toccoa River mile 56.8	CHC	3384	3.20	0.01K	0.01K	0.50K	0.01K	0.01K	0.01	0.01K	0.01K	0.01K	0.10K
Nottely Reservoir													
Nottely River mile 27.5	CHC	3373	3.30	0.01K	0.01K	0.50K	0.01K	0.01K	0.03	0.01K	0.01K	0.01K	0.10K
Watts Bar Reservoir													
Emory River mile 7.5	LMB	3763	1.00	0.01K	0.01K	0.50K	0.01K	0.01	0.01	0.01K	0.01K	0.01K	0.11
Emory River mile 7.5	CHC	3764	2.10	0.01K	0.01K	0.50K	0.01K	0.03	0.01	0.01K	0.01K	0.01K	0.55
Emory River mile 7.5	C	3765	1.10	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Powell River													
Powell River mile 65.3	SPB	3757	0.60	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Powell River mile 65.3	DRM	3758	1.50	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Powell River mile 65.3	CHC	3759	3.80	0.01K	0.01K	0.50K	0.01K	0.03	0.01K	0.01K	0.01K	0.01K	0.10K

Table 4 (Continued)

Collection Site	Species ^a	LABID	Lipid (%)	Benzene				DDTr	Endo-sulfan	Endrin	Hepta-chlor	PCBs
				Aldrin	Dieldrin	Toxophene	Hexachlo					
Fontana Reservoir												
L. Tennessee River mile 62.5	CHC	3381	3.00	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
L. Tennessee River mile 81.0	CHC	3380	3.10	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
French Broad River												
French Broad River mile 71.4	C	3771	1.80	0.01K	0.01K	0.50K	0.01K	0.01	0.01K	0.01K	0.01K	0.11
French Broad River mile 71.4	CHC	3772	2.20	0.01K	0.01K	0.50K	0.01K	0.04	0.01K	0.01K	0.01K	0.10K
French Broad River mile 71.4	LMB	3773	0.80	0.01K	0.01K	0.50K	0.01K	0.01	0.01K	0.01K	0.01K	0.10K
Nolichucky River												
Nolichucky River mile 5.3	Bass	3760	0.40	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10
Nolichucky River mile 5.3	CHC	3761	2.30	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Nolichucky River mile 5.3	C	3762	1.80	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.22
Cherokee River												
Holston River mile 53.0	FHC	3433	9.40	0.01K	0.01K	0.50K	0.01K	0.01K	0.03	0.01K	0.01K	0.33
Holston River												
Holston River mile 109.9	CAT	3754	10.00	0.01K	0.01	0.50K	0.01K	0.11	0.01	0.01K	0.01K	0.28
Holston River mile 109.9	LMB	3755	0.80	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10
Holston River mile 109.9	CAT	3756	2.40	0.01K	0.01K	0.50K	0.01K	0.02	0.01K	0.01K	0.01K	0.16
Watauga Reservoir												
Watauga River mile 48.0	CHC	3382	11.00	0.01K	0.01K	0.50K	0.01K	0.01K	0.06	0.01K	0.01K	0.10K
Barkley Reservoir												
Cumberland River mile 59.0	CHC	3379	4.20	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.01K	0.01K	0.10K
Cheatham Reservoir												
Cumberland River mile 176.0	CHC	3378	4.20	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.04	0.01K	0.10K

Table 4 (Continued)

Collection Site	Species ^a	LABID (%)	Lipid	Aldrin	Dieldrin	Toxophene	Benzene Hexachlo	Chlordane	DDTr	Endo- sulfan	Endrin	Hepta- chlor	PCBs
Old Hickory Reservoir													
Cumberland River mile 217.0	CHC	3375	1.90	0.01K	0.01K	0.50K	0.01K	0.01K	0.02	0.01K	0.01K	0.01K	0.10K
Cumberland River mile 236.0	CHC	3376	5.80	0.01K	0.01K	0.50K	0.01K	0.01K	0.01K	0.04	0.01K	0.01K	0.13

a. Species abbreviations: CHC = channel catfish; BLC = blue catfish; FHC = flathead catfish; LMB = largemouth bass; SMB = smallmouth bass; SPB = spotted bass; C = carp; DRM = drum; SBU = smallmouth buffalo.

b. K--used to signify less than detection level identified.

Table 5. Selected 1988 Results from Reservoir and Inflow Sites Which Show Need for Further Evaluation Based on Preselected Tiered Criteria

Location	Species	Tier 1		Tier 2
		Resampling at Screening Level ($\mu\text{g/g}$)		Conduct Intensive Study
Hiwassee River mile 15 ^a	Largemouth bass	Mercury	0.47	-
Ocoee River mile 12	Channel catfish	PCBs	1.1	-
Ocoee River mile 12	Channel catfish	Selenium	1.0	-
Hiwassee River mile 83	Channel catfish	Mercury	0.48	-
Nottely River mile 28	Channel catfish	Mercury	0.44	-
Holston River mile 110 ^a	Catfish	Chlordane	0.11	-

a. Inflow sites

Table 6. Concentrations ($\mu\text{g/g}$) of Metals in Compositied Catfish Livers from Reservoir Sites

[illegible]

Table 6 (Continued)

[illegible]

Table 6 (Continued)

Location	Species ^a	LABID	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Nolichucky River			N/A												
Nolichucky River mile 5.3	CHC														
Nolichucky River mile 5.3	C														
Nolichucky River mile 5.3	LM/SMB														
Cherokee Reservoir															
Hiwassee River mile 83.0	FHC	3434	<2.0	<0.02	<0.02	0.16	0.04	<2.0	0.19	0.33	<1.0	0.88	<0.1	<1.0	15
John Sevier Detention Reservoir															
Holston River mile 110	CH/BLC	N/A													
Holston River mile 110	C														
Holston River mile 110	LMB														
Watauga Reservoir															
Watauga River mile 48.0	CHC	3400	<2.0	<0.02	<0.02	0.16	0.05	<2.0	0.06	0.70	<1.0	1.4	<0.1	1.0	23
Barkley Reservoir															
Cumberland River mile 59.0	CHC	3397	<2.0	0.03	<0.02	0.06	0.03	<2.0	0.08	0.17	1.0	0.81	<0.1	<1.0	20
Chaetum Reservoir															
Cumberland River mile 176.0	CHC	3396	<2.0	0.02	<0.02	0.12	0.12	<2.0	0.14	0.27	1.0	0.78	<0.1	1.0	22
Old Hickory Reservoir															
Cumberland River mile 217.0	CHC	3393	<2.0	0.05	<0.02	0.16	0.19	<2.0	0.09	0.23	<1.0	0.76	<0.1	<1.0	23
Cumberland River mile 236.0	CHC	3394	<2.0	0.05	<0.02	0.12	0.07	<2.0	0.10	0.17	1.0	0.77	<0.1	2.0	21

a. Species abbreviations: CHC = channel catfish; BLC = blue catfish; FHC = flathead catfish; LMB = largemouth bass; SMB = smallmouth bass; SPB = spotted bass; C = carp; DRM = drum; SBU = smallmouth buffalo.

Table 7. Highest and Second Highest Concentrations ($\mu\text{g/g}$) of Each Contaminant in Fillets (by Collection Site) Found in Fish Tissue Screening Studies in 1988

Parameter	Detection Limit	Highest Concentration Found			Second Highest Concentration Found		
		Level	Location ^a	Sample	Level	Location ^a	Sample
Antimony	2.0	ND	-	-	-	-	-
Arsenic	0.02	0.28	TRM 210	cat	0.18	TRM 339	cat
Beryllium	0.02	0.04	EmRM 8.0	cat	ND	-	-
Cadmium	0.02	0.42	PRM 65	game	0.36	FBRM 71	game
Chromium	0.02	0.12	TRM 255	cat	0.09	TRM 382	cat
Copper	2.0	ND	-	-	-	-	-
Lead	0.02	0.62	PRM 65	rough & game	0.52	HRM 110	rough
Mercury	0.02	0.48	HIRM 83	cat	0.47	HIRM 15	game
Nickel	1.0	2.0	HIRM 83	cat	ND	-	-
Selenium	0.02	1.0	ORM 12	cat	0.72	PRM 65	rough
Silver	0.1	ND	-	-	-	-	-
Thallium	1.0	4.0	TRM 97	cat	3.0	CuRM	cat
		1.0	HIRM	rough			
Zinc	0.1	23	NoIRM 5	rough	19	FBRM 71	rough
Aldrin	0.01	ND	-	-	-	-	-
BHC	0.01	0.02	TRM 270 and 339	cat	0.01	TRM 97, 235 and 255	cat
Chlordane	0.01	0.11	HRM 110	cat	0.04	TRM 415 and FBRM 71	cat cat
DDTr	0.01	1.2	TRM 300	cat	1.0	TRM 339	cat
Dieldrin	0.01	0.01	HRM 110	cat	ND	-	-
Endosulfan	0.01	0.06	ORM 12	-	0.05	TRM 210	cat
Endrin	0.01	0.03	TRM 415	cat	0.02	TRM 339	cat
Heptachlor	0.01	0.01	TRM 350	cat	ND	-	-
Toxaphene	0.5	ND	-	-	-	-	-
PCBs	0.1	1.0	ORM 12	cat	0.74	TRM 339	cat

a. Location abbreviations:

TRM--Tennessee River mile
EmRM--Emory River mile
PRM--Powell River mile
HIRM--Hiwassee River mile
ORM--Ocoee River mile
NoIRM--Nolichucky River mile
HRM--Holston River mile
CuRM--Cumberland River mile
FBRM--French Broad River mile

Table 8. Listing of Collection Sites for Valley-Wide Fish Tissue Screening Study for Autumn 1989

Site ^a	Site ^a
Lower Tennessee River	Tims Ford Reservoir
Tennessee River mile 7	Elk River mile 135
Tennessee River mile 21	Elk River mile 150
Kentucky Reservoir	Guntersville Reservoir
Tennessee River mile 30	Tennessee River mile 350
Tennessee River mile 60	Tennessee River mile 382
Big Sandy River mile 5	Tennessee River mile 415
Tennessee River mile 100	Chickamauga Reservoir
Tennessee River mile 135	Tennessee River mile 483
Tennessee River mile 173	Tennessee River mile 526
Tennessee River mile 200	Hiwassee River mile 5
Pickwick Reservoir	Parksville Reservoir
Tennessee River mile 210	Ocoee River mile 12
Tennessee River mile 235	Douglas Reservoir
TRM 255	French Broad River mile 35
Wheeler Reservoir	French Broad River mile 42
Tennessee River mile 275	French Broad River mile 55
Tennessee River mile 300	
Tennessee River mile 339	

a. Fish from other mainstem reservoirs (Wilson, Nickajack, Watts Bar, and Fort Loudoun) will be sampled in autumn as parts of other studies.

APPENDIXES

APPENDIX A

Table A1. Listing of Collection Sites Included in the Valley-Wide Fish Tissue Study
Including Needed Frequency of Collections and Existence of Historic Information
from Each General Area (see footnote for explanation of abbreviations)

Collection Sites ^a	Needed Frequency (Year)	Sampled Prior to 1984	Calendar Year					
			1984	1985	1986	1987	1988	1989
Lower Tennessee River								
Tennessee River mile	3	M,*0	DUK	M,0	M,0	OS-O,M	D-NN	D-N
Tennessee River mile 7								
Tennessee River mile 21	3	M,0	DUK	DUK	M,0	OS-O,M	D-NN	D-N
Kentucky Reservoir ^b								
Tennessee River mile 30	3	DUK	DUK	DUK	0	OS-O,M	VW-M,0	D-N
Tennessee River mile 60	3	M	DUK	DUK	DUK	OS-O,M	VW-M,0	D-N
Big Sandy River mile 5	3	DUK	DUK	DUK	DUK	OS-O,M	VW-M,0	D-N
Tennessee River mile 100	3	M,0	DUK	M,0	DUK	OS-O,M	VW-M,0	D-N
Tennessee River mile 135	3	DUK	DUK	M,0	DUK	OS-O,M	NC	D-N
Tennessee River mile 173	3	DUK	DUK	DUK	DUK	OS-M	VW-M,0	D-N
Tennessee River mile 200	3	DUK	DUK	0	DUK	OS-O,M	VW-M,0	D-N
Duck River								
Duck River mile 18.5	SWMS Annual	DUK	M,0	DUK	M,0	NC	NC	OS-O,M
Normandy Reservoir								
Duck River mile 251	4	DUK	DUK	M,0	DUK	VW-O,M	VW-M,0	D-NN
Pickwick Reservoir								
Tennessee River mile 210	3	M,0	DUK	M,0	DUK	D-NN	VW-M,0	D-N
Tennessee River mile 235	3	M,0	DUK	M,0	DUK	D-NN	VW-M,0	D-N
Tennessee River mile 255	3	M,0	M,0	M,0	0	D-NN	VW-M,0	D-N
Bear Creek Reservoir								
Bear Creek lower	4	DUK	DUK	DUK	DUK	VW-O,M	D-NN	D-NN
Upper Bear Creek lower	4	DUK	DUK	DUK	DUK	VW-O,M	D-NN	D-NN
Little Bear Creek lower	4	DUK	DUK	DUK	DUK	VW-O,M	D-NN	D-NN
Cedar Creek lower	4	DUK	DUK	DUK	DUK	VW-O,M	D-NN	D-NN
Wilson Reservoir								
Tennessee River mile 260	3	M,0	M,0	0	0	OS-O	VW-M,0	OS-O
Tennessee River mile 270	3	M,0	M,0	0	0	OS-O	VW-M,0	OS-O
Wheeler Reservoir								
Tennessee River mile 275	3	DUK	DUK	M,0	DUK	D-NN	NC	D-N
Tennessee River mile 300	3	DUK	DUK	M,0	DUK	D-NN	VW-M,0	D-N
Tennessee River mile 339	3	DUK	DUK	M,0	DUK	OS-R,NP	VW-M,0	D-N
Elk River								
Elk River mile 31.0	SWMS Annual	DUK	DUK	DUK	M,0	OS-M,0	NC	OS-M,0

Table A1 (Continued)

Collection Sites ^a	Needed Frequency (Year)	Sampled Prior to 1984	Calendar Year					
			1984	1985	1986	1987	1988	1989
Tims Ford Res. ERM 135	3	M,0	DUK	DUK	DUK	VW-M,0	NC	D-N
Tims Ford Res. ERM 150	3	DUK	DUK	DUK	DUK	VW-M,0	NC	D-N
Woods Res. Lower	3	M,0	DUK	0	0	OS-0	D-NN	D-NN
Guntersville Reservoir								
Tennessee River mile 350	3	DUK	DUK	M,0	DUK	OS-R,NP	VW-M,0	D-N
Tennessee River mile 382	3	DUK	DUK	M,0	DUK	OS-R,NP	VW-M,0	D-N
Tennessee River mile 415	3	DUK	DUK	M,0	DUK	OS-M,0	VW-M,0	D-N
Nickajack Reservoir								
Tennessee River mile 425	3	M,0	DUK	DUK	DUK	VW-M,0	OS-0	OS-0
Tennessee River mile 457	3	M,0	DUK	DUK	DUK	VW-M,0	OS-0	OS-0
Chickamauga Reservoir								
Lower	ONP	M,0	M,0	DUK	DUK	OS-M,0	OS-M,0	OS-M,0
	Annual							
Hiwassee River	ONP	M,0	DUK	DUK	DUK	OS-M,0	OS-M,0	OS-M,0
(impounded)	Annual							
Upper	ONP	DUK	DUK	DUK	DUK	OS-M,0	OS-M,0	OS-M,0
	Annual							
Hiwassee River								
Hiwassee River mile 14	SWMS	DUK	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
	Annual							
Hiwassee Res. Lower	4	DUK	DUK	DUK	DUK	D-N	VW-M,0	D-NN
Chatuge Res. Lower	4	DUK	DUK	DUK	DUK	D-N	VW-M,0	D-NN
Nottely Res. Lower	4	DUK	DUK	DUK	DUK	VW-M,0	VW-M,0	D-NN
Ocoee (Parksville)	3	DUK	M,0	DUK	DUK	VW-M,0	VW-M,0	Resample
Lower								Tier 2
Blue Ridge Lower	4	DUK	DUK	DUK	DUK	D-N	VW-M,0	D-NN
Watts Bar Reservoir								
Tennessee River mile 532	3	M,0	M,0	DUK	DUK	D-N	OS-0	OS-M,0
Tennessee River mile 567	3	DUK	M,0	DUK	DUK	OS-0	OS-0	OS-M,0
Tennessee River mile 602	3	DUK	DUK	0	0	OS-0	OS-0	OS-M,0
Clinch River								
Clinch River mile 20	3	DUK	M,0	DUK	DUK	VW-M,0	OS-0	OS-M,0
Emory River mile 7.5	SWMS	DUK	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
	Annual							

Table A1 (Continued)

Collection Sites ^a	Needed Frequency (Year)	Sampled Prior to 1984	Calendar Year					
			1984	1985	1986	1987	1988	1989
Melton Hill Res. CRM 24	4	DUK	DUK	DUK	DUK	VW-M,0	OS-0	OS-M,0
Melton Hill Res. CRM 39	4	DUK	DUK	DUK	DUK	VW-M,0	OS-0	OS-M,0
Norris Res. Lower	4	DUK	DUK	DUK	DUK	VW-M,0	D-NN	OS-M,0
Norris Res. Powell Arm	4	M	DUK	DUK	DUK	VW-M,0	D-NN	D-NN
Mid								
Norris Res. Clinch Arm	4	DUK	DUK	DUK	DUK	VW-M,0	D-NN	D-NN
Mid								
Powell River mile 65.2	SWMS Annual	M,0	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
Fort Loudoun Reservoir								
Tennessee River mile 604	3	0	DUK	0	0	D-NN	OS-0	OS-0
Little River mile 3.0	3	0	M,0	0	0	OS-0	OS-0	OS-0
Tennessee River mile 651	3	0	M,0	0	0	D-NN	OS-0	OS-0
Little Tennessee River								
Tellico Res. LTRM 1.0	3	DUK	DUK	0	0	OS-0	OS-0	OS-0
Tellico Res. LTRM 11	3	M,0	DUK	0	0	OS-0	OS-0	OS-0
Chilhowee Res. Lower	3	DUK	DUK	DUK	0	OS-0	D-NN	OS-0
Calderwood Res. Lower	4	DUK	DUK	DUK	DUK	OS-0	D-NN	D-NN
Cheoah Res. Lower	4	DUK	DUK	DUK	DUK	OS-0	D-NN	D-NN
Santeetlah Res. Lower	4	DUK	DUK	DUK	DUK	OS-0	D-NN	D-NN
Fontana Res. LTRM 62	4	DUK	DUK	DUK	DUK	VW-M,0 & OS-0	VW-M,0	D-NN
Fontana Res. LTRM 81	4	DUK	DUK	DUK	DUK	VW-M,0 & OS-0	VW-M,0	D-MN
French Broad River								
Douglas Res. FBRM 35	3	DUK	M,0	DUK	DUK	VW-M,0	D-N	D-N
Douglas Res. FBRM 42	3	DUK	DUK	DUK	DUK	VW-M,0	D-N	D-N
Douglas Res. FBRM 55	3	DUK	M,0	DUK	DUK	VW-M,0	D-N	D-N
French Broad River mile 71.4	SWMS Annual	M,0	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
Nolichucky River mile 5.3	SWMS Annual	DUK	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
Holston River								
Cherokee Res. Lower	3	DUK	DUK	DUK	DUK	OS-M,0	VW-M,0	D-NN
Cherokee Res. HRM 73	3	M,0	M,0	DUK	DUK	VW-M,0	D-N	D-N
Cherokee Res. Upper	3	M,0	M,0	DUK	DUK	OS-M,0	D-N	D-N
Holston River mile 110	SWMS Annual	DUK	DUK	DUK	M,0	OS-M,0	OS-M,0	OS-M,0
Fort Pat. Res. Lower	4	DUK	DUK	M,0	DUK	OS-M,0	D-NN	D-NN

Table A1 (Continued)

Collection Sites ^a	Needed Frequency (Year)	Sampled Prior to 1984	Calendar Year					
			1984	1985	1986	1987	1988	1989
Boone Res.-Wat. R. Side	3	M,O	M,O	M,O	DUK	OS-M,O	D-NN	D-NN
Boone Res.-So. Hol. R. Side	3	M,O	M,O	M,O	DUK	OS-M,O	D-NN	D-NN
Watauga Res.--Middle	4	DUK	DUK	DUK	DUK	D-N	VW-M,O	D-NN
South Holston Res. Lower	4	DUK	M,O	M,O	DUK	OS-M,O	D-NN	D-NN
Cumberland River								
Barkley Res. Lower	3	DUK	DUK	DUK	DUK	D-N	VW-M,O	D-NN
Barkley Res. Middle	3	DUK	DUK	DUK	DUK	VW-M,O	D-NN	D-NN
Barkley Res. Upper	3	DUK	DUK	DUK	DUK	VW-M,O	D-NN	D-NN
Cheatham Res. Middle	3	DUK	DUK	DUK	DUK	D-N	VW-M,O	D-NN
Old Hickory Res. Lower	3	DUK	DUK	DUK	DUK	D-N	VW-M,O	D-NN
Old Hickory Res. Upper	3	DUK	DUK	DUK	DUK	D-N	VW-M,O	D-NN

*Abbreviation:

- M = Metals (One or more heavy metals)
- O = Organic (One or more organic compounds)
- DUK = Data unknown, assumed that no data exist
- OS = Other study to provide information on metals (M)
and/or organics (O)
- NC = Samples not collected as planned
- SWMS = Surface Water Monitoring Strategy program
- OS-R,NP = Other study recommended, not planned
- ONP = Office of Nuclear Power (TVA)
- D-N = Data needed
- D-NN = Data not needed
- VW-M,O = Valley-wide Fish Tissue Study Metals and Organics

- a. Location abbreviations: CRM = Cove Creek mile; ERM = Elk River mile; LTRM = Little Tennessee River mile; FBRM = French Broad River mile.
- b. Two sites were added to Kentucky Reservoir in 1988 to provide more thorough coverage (Big Sandy Creek and TRM 173).

APPENDIX B

Table B1. Analytical Methodology for Valley-Wide Fish Tissue Study

Parameter	Reference ^a	Methodology	Detection Limit ((µg/g)
Preparation of sample for analysis	Reference 1, Method 41.200.3	Dry ice blending of 5-fish composite for metals; grinding of 5-fish composite for pesticides, DDT _r , and PCBs	-
Digestion for metals	Reference 1, Method 41.200.2	HNO ₃ -H ₂ O ₂	-
Antimony	Reference 1, Method 30.200.2	ICP	2
Arsenic	Reference 1, Method 41.206.1	AA-furnace	0.02
Beryllium	Reference 1, Method 30.200.2	ICP	0.02
Cadmium	Reference 1, Method 30.200.2	ICP	0.1
Chromium	Reference 1, Method 41.221.1	AA-Furnace	0.02
Copper	Reference 1, Method 30.200.2	ICP	0.2
Lead	Reference 1, Method 41.244.1	AA-Furnace	0.02
Mercury	Reference 2, pages 34-37	Cold vapor	0.1
Nickel	Reference 1, Method 30.200.7	ICP	1
Selenium	Reference 1, Method 41.276.1	AA-Furnace	0.02
Silver	Reference 1, Method 30.200.2	ICP	0.2
Thallium	Reference 1, Method 30.200.2	ICP	1
Zinc	Reference 1, Method 30.200.7	ICP	0.1
PCBs	Reference 1, Method 41.418.1	Mechanical dispersion Sulfuric acid cleanup GC/EC	0.1
DDT _r	Reference 1, Method 41.418.1	Mechanical dispersion Sulfuric acid cleanup GC/EC	0.01
Pesticides	Reference 3	Mechanical dispersion GCP cleanup, GC/EC	Various

a. References

1. Laboratory Branch Quality Manual.
2. "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue," EPA 600/4-81-055, Environmental Protection Agency, Cincinnati, Ohio, October 1980.
3. "Extraction and Analysis of Priority Pollutants in Biological Tissue," Method ppb 12/83, U.S. Environmental Protection Agency, Environmental Services Division, Region IV, Analytical Support Branch, Athens, Georgia.